

- 1 1. An integrated Fischer-Tropsch process comprising the steps of:
 - 2 (a) producing a synthetic crude by Fischer-Tropsch reaction of synthesis gas;
 - 3 (b) fractionating the synthetic crude at least into a light Fischer Tropsch liquid, and
 - 4 a heavy Fischer Tropsch liquid wherein the light Fischer-Tropsch liquid comprises alcohols;
 - 5 (c) contacting at least a part of the light Fischer Tropsch liquid with a dehydration
 - 6 catalyst to dehydrate alcohols in the light Fischer Tropsch liquid to corresponding alpha- and
 - 7 internal-olefins to form a dehydrated product;
 - 8 (d) oligomerizing in an oligomerization reactor all or part of the dehydrated product
 - 9 produced in step (c) to form a product comprising a heavy branched olefin stream;
 - 10 (e) hydroprocessing the heavy Fischer-Tropsch liquid to form a heavy crude
 - 11 baseoil; and
 - 12 (f) introducing the heavy branched olefin stream and crude baseoil into a
 - 13 hydrofinisher to produce a synthetic lubricant crude basestock.
- 1 2. The process of claim 1 wherein the hydroprocessing step (e) comprises the steps of:
 - 2 (e1) hydrocracking the HFTL;
 - 3 (e2) hydrodewaxing all or part of the hydrocracked HFTL; and
 - 4 (e3) fractionating the product of (e2) to recover a heavy crude baseoil.
- 1 3. The process of claim 1 wherein the hydroprocessing step (e) comprises the steps of:
 - 2 (e4) hydrotreating the HFTL to form a hydrotreated HFTL;
 - 3 (e5) hydrocracking the hydrotreated HFTL;
 - 4 (e6) hydrodewaxing all or part of the product of (e5); and
 - 5 (e7) fractionating the product of (e6) to recover a heavy crude baseoil.
- 1 4. The process of claim 1 wherein the hydroprocessing step (e) comprises the steps of:
 - 2 (e8) hydrocracking the HFTL to form a hydrocracked HFTL;
 - 3 (e9) fractionating the hydrocracked HFTL to recover a lighter and a heavier fraction;
 - 4 (e10) recycling a portion of the heavier fraction from step (e9) into the hydrocracker
 - 5 of step (e8); and
 - 6 (e11) hydrodewaxing the hydrocracked heavier fraction from step (e10).

- 1 5. The process of claim 1 wherein the dehydrated light Fischer-Tropsch liquid produced in
2 step (c) is fractionated to recover a C₉-C₁₈ fraction and wherein the C₉-C₁₈ fraction is
3 oligomerized in step (d).
- 1 6. The process of claim 1 wherein the oligomerization of step (d) is catalyzed by a BF₃/co-
2 catalyst system.
- 1 7. The process of claim 6 wherein the co-catalyst is an oxygen containing compound.
- 1 8. The process of claim 7 wherein the co-catalyst is selected from the group of mono-alcohols,
2 glycol ethers, and polyglycol ethers.
- 1 9. The process of claim 1 wherein the oligomerization of step (d) occurs at temperatures from
2 about 50° to about 300°F.
- 1 10. The process of claim 6 wherein the BF₃ is present in an amount from about 10 to about 150
2 parts per one-thousand parts of reactant by weight and the co-catalyst is present in an
3 amount from about 10 to about 200 parts per one-thousand parts of reactant by weight.
- 1 11. The process of claim 1 wherein the oligomerization of step (d) is catalyzed by a catalyst
2 system selected from the group of AlCl₃/co-catalyst, H₃PO₄, and solid acidic resin catalysts.
- 1 12. The process of claim 1 wherein the dehydrated product of step (c) is fractionated to recover
2 a C₉-C₁₃ fraction and wherein the C₉-C₁₃ fraction is the dehydrated light Fischer-Tropsch
3 liquid used in step (d).
- 1 13. The process of claim 1 wherein the dehydrated light Fischer-Tropsch liquid produced in
2 step (c) is fractionated to recover a C₁₄-C₁₈ fraction and wherein the C₁₄-C₁₈ fraction is
3 oligomerized in step (d).
- 1 14. The process of claim 1 further comprising the step of isomerizing at least a part of the
2 dehydrated product of step (c) prior to oligomerization in step (d).
- 1 15. The process of claim 1 wherein the synthesis gas is produced by autothermal reaction in the
2 presence of nitrogen.
- 1 16. The process of claim 1 wherein the dehydration catalyst is selected from the group of
2 treated activated alumina and treated activated silica-alumina.
- 1 17. The process of claim 1 further comprising the steps of:
 - 2 (g) fractionating the product of step (d) to isolate a nonoligomerized olefin/paraffin stream;
3 and
 - 4 (h) dehydrogenating the nonoligomerized olefin/paraffin stream by contacting it with a
5 dehydrogenation catalyst.

1 18. The process of claim 17 wherein the dehydrogenation catalyst comprises a Group VIII
2 metal supported on a high-surface inorganic support.

1 19. The process of claim 17 further comprising the step of:

2 (i) passing the product of step (h) into the oligomerization reactor.

1 20. The process of claim 1 further comprising the step of fractionating the synthetic lubricant
2 crude basestock to recover a synthetic lubricant basestock product containing essentially no
3 unsaturated hydrocarbons and essentially no hydrocarbons having a carbon number of less
4 than 15.

1 21. An integrated Fischer-Tropsch process comprising the steps of:

2 (a) producing a synthetic crude by Fischer-Tropsch reaction of synthesis gas;

3 (b) fractionating the synthetic crude at least into a light Fischer Tropsch liquid, and
4 a heavy Fischer Tropsch liquid wherein the light Fischer-Tropsch liquid comprises alcohols;

5 (c) subjecting at least some of the light Fischer-Tropsch liquid to means for
6 dehydrogenating hydrocarbons to produce a dehydrogenated light Fischer-Tropsch liquid;

7 (d) oligomerizing in an oligomerization reactor at least a portion of the
8 dehydrogenated light Fischer-Tropsch liquid to form a product comprising a heavy branched
9 olefin stream;

10 (e) hydroprocessing the heavy Fischer-Tropsch liquid to form a heavy crude
11 baseoil; and

12 (f) introducing the heavy branched olefin stream and heavy crude baseoil into a
13 hydrofinisher to produce a synthetic lubricant crude basestock.

1 22. The process of claim 21 wherein the hydroprocessing step (e) comprises the steps of:

2 (e1) hydrocracking the HFTL;

3 (e2) hydrodewaxing all or part of the hydrocracked HFTL; and

4 (e3) fractionating the product of (e2) to recover a heavy crude baseoil.

1 23. The process of claim 21 wherein the hydroprocessing step (e) comprises the steps of:

2 (e4) hydrotreating the HFTL;

3 (e5) hydrocracking the hydrotreated HFTL;

4 (e6) hydrodewaxing all or part of the product of (e5); and

5 (e7) fractionating the product of (e6) to recover a heavy crude baseoil.

1 24. The process of claim 21 wherein the hydroprocessing step (e) comprises the steps of:

2 (e8) hydrocracking the HFTL;

3 (e9) fractionating the hydrocracked HFTL to recover a heavy crude baseoil and a
4 heavier fraction;

5 (e10) recycling a portion of the heavier fraction from step (e9) into the hydrocracker
6 of step (e8); and

7 (e11) hydrodewaxing the hydrocracked heavier fraction from step (e10).

1 25. The process of claim 21 wherein the dehydrated light Fischer-Tropsch liquid produced in
2 step (c) is fractionated to recover a C₉-C₁₈ fraction and wherein the C₉-C₁₈ fraction is
3 oligomerized in step (d).

1 26. The process of claim 21 wherein the oligomerization of step (d) is catalyzed by a BF₃/co-
2 catalyst system.

1 27. The process of claim 26 wherein the co-catalyst is an oxygen containing compound.

1 28. The process of claim 27 wherein the co-catalyst is selected from the group of mono-
2 alcohols, glycol ethers, and polyglycol ethers.

1 29. The process of claim 21 wherein the oligomerization of step (d) occurs at temperatures
2 from about 50° to about 300°F.

1 30. The process of claim 26 wherein the BF₃ is present in an amount from about 10 to about
2 150 parts per one-thousand parts of reactant by weight and the co-catalyst is present in an
3 amount from about 10 to about 200 parts per one-thousand parts of reactant by weight.

1 31. The process of claim 21 wherein the oligomerization of step (d) is catalyzed by a catalyst
2 system selected from the group of AlCl₃/co-catalyst, H₃PO₄, and solid acidic resin catalysts.

1 32. The process of claim 21 further comprising the steps of:

2 (g) contacting at least a part of the light Fischer Tropsch liquid with a dehydration catalyst
3 to dehydrate alcohols in the light Fischer Tropsch liquid to corresponding alpha- and
4 internal-olefins to form a dehydrated product; and

5 (h) oligomerizing in the oligomerization reactor at least a portion of the dehydrated product
6 produced in step (g) to form a product comprising a heavy branched olefin stream.

1 33. The process of claim 32 wherein the dehydration catalyst is selected from the group of
2 treated activated alumina and treated activated silica-alumina.

- 1 34. The process of claim 32 wherein the dehydrated product of step (g) is fractionated to
2 recover a C₉-C₁₃ fraction and wherein the C₉-C₁₃ fraction is the dehydrated light Fischer-
3 Tropsch liquid used in step (d).
- 1 35. The process of claim 32 wherein the dehydrated product produced in step (g) is fractionated
2 to recover a C₁₄-C₁₈ fraction and wherein the C₁₄-C₁₈ fraction is oligomerized in step (d).
- 1 36. The process of claim 32 further comprising the step of isomerizing at least a part of the
2 dehydrated product of step (c) prior to oligomerization in step (d).
- 1 37. The process of claim 21 further comprising the steps of:
 - 2 (i) fractionating the product of step (d) to isolate a nonoligomerized olefin/paraffin stream;
3 and
 - 4 (j) dehydrogenating the nonoligomerized olefin/paraffin stream by contacting it with a
5 dehydration catalyst.
- 1 38. The process of claim 37 wherein the dehydrogenation catalyst is platinum supported on a
2 high-surface alumina.
- 3 39. The process of claim 37 further comprising the step of:
 - 4 (k) passing the product of step (j) into the oligomerization reactor.
- 1 40. The process of claim 21 further comprising the step of fractionating the synthetic lubricant
2 crude basestock to recover a synthetic lubricant basestock product containing essentially no
3 unsaturated hydrocarbons and essentially no hydrocarbons having a carbon number of less
4 than 15.
- 5 41. The process of claim 1 wherein the synthesis gas is produced by autothermal reaction in the
6 presence of nitrogen.
- 7 42. A high stability synthetic lubricant crude basestock produced by the process of claim 1
8 having a BI of between about 23.4% and about 25.5% and a DM of between about 18%
9 and about 21.2% such that DM \geq 2BI - 29.9.
- 10 43. The high stability synthetic lubricant crude basestock produced by the process of claim 1
11 wherein the BI is between about 23.4% and 24.7% and the DM is between about 20.4% and
12 about 21.2%.

13 44. The high stability synthetic lubricant crude basestock of claim 43 wherein the BI is about
14 24.4% and the DM is about 21.1%

1 45. A high stability synthetic lubricant crude basestock produced by the process of claim 1
2 having a BI of 25.5% or less and DM of 21.2% or lower such that $DM \geq 2BI - 29.9$.

1 46. A high stability synthetic lubricant crude basestock produced by the process of claim 21
2 having a BI of 25.5% or less and DM of 21.2% or lower such that $DM \geq 2BI - 29.9$.

1 47. A high stability synthetic lubricant crude basestock produced by the process of claim 21
2 having a BI of between about 23.4% and about 25.5% and a DM of between about 18%
3 and about 21.2% such that $DM \geq 2BI - 29.9$.

4 48. The high stability synthetic lubricant crude basestock produced by the process of claim 21
5 wherein the BI is between about 23.4% and 24.7% and the DM is between about 20.4% and
6 about 21.2%.

7 49. The high stability synthetic lubricant crude basestock of claim 48 wherein the BI is about
8 24.4% and the DM is about 21.1%

1 50. A lubricant baseoil composition produced by an integrated Fischer-Tropsch process
2 comprising at least 40% of methyl branched hydrocarbons, characterized by BI of between
3 about 23.4% and about 25.5% and a DM of between about 18% and about 25.5% and at
4 least 5% long-chain branched hydrocarbons wherein the branches have a carbon number of
5 at least 2, and are characterized by BI of less than about 24% and a DM of less than about
6 21%, wherein the lubricant baseoil arises from both Fischer-Tropsch oil and Fischer-
7 Tropsch wax.

1 51. The lubricant baseoil composition of claim 50 wherein the methyl branched hydrocarbons
2 are characterized by a BI of about 25% and a DM of about 20%.

1 52. The lubricant baseoil composition of claim 50 wherein the long-chain branched
2 hydrocarbons are characterized by a BI of about 21% and a DM of about 19%.

1 53. A lubricant baseoil composition produced by an integrated Fischer-Tropsch process
2 comprising at least about 40% of methyl branched hydrocarbons with a pour point of at
3 most -10°C , and at least about 5% long chain branched hydrocarbons having a pour point
4 equal to or less than -30°C .

1 54. A lubricant baseoil composition produced by an integrated Fischer-Tropsch process
2 comprising at least about 40% of methyl branched hydrocarbons and at least about 5% long
3 chain branched hydrocarbons wherein the baseoil composition has a pour point of about
4 -20°C .

1 55. The process of claim 1 further comprising the step of fractionating the synthetic lubricant
2 crude basestock.

- 1 56. A synthetic lubricant crude basestock produced by the process of claim 1 which comprises
- 2 between about 15 and about 25 vol% 2cSt product, between about 15 and about 25 vol% 3
- 3 cSt product, between about 20 and about 30 vol% 5 cSt product, between about 20 and
- 4 about 30 vol% 6 cSt product and between about 12 and about 18 vol% product having a
- 5 viscosity of greater than 6 cSt.
- 1 57. A synthetic lubricant crude basestock produced by the process of claim 1 wherein 4 cSt and
- 2 heavier products comprise at least 40% of the total lubricant crude basestock.
- 1 58. A synthetic lubricant crude basestock produced by the process of claim 21 which comprises
- 2 between about 15 and about 25 vol% 2cSt product, between about 15 and about 25 vol% 3
- 3 cSt product, between about 20 and about 30 vol% 5 cSt product, between about 20 and
- 4 about 30 vol% 6 cSt product and between about 12 and about 18 vol% product having a
- 5 viscosity of greater than 6 cSt.
- 1 59. A synthetic lubricant crude basestock produced by the process of claim 21 wherein 4 cSt
- 2 and heavier products comprise at least 40% of the total lubricant crude basestock.
- 1 60. The process of claim 1 wherein the lubricant crude basestock comprises 2 cSt, 3 cSt, 4 cSt,
- 2 and higher cSt components and wherein the ratio of 2 cSt plus 3 cSt component to 4 cSt and
- 3 higher cSt components is between about 0.8 and about 1.2.
- 1 61. The process of claim 18 wherein the Group VIII metal is palladium.
- 1 62. The process of claim 18 wherein the Group VIII metal is nickel.
- 1 63. The process of claim 18 wherein the high-surface inorganic support is high-surface
- 2 alumina.
- 1 64. The process of claim 18 wherein the Group VIII metal is palladium and the high-surface
- 2 inorganic support is high-surface alumina.